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Comparative Study of the Effects of Beverages on Ciprofloxacin and Ibuprofen

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Abstract

The activity of drug can be affected when food and drug interacts on patient consumption. The study of this interaction is important as it gives adequate dosing, time and new drug formulation. The importance of food and drug interactions has placed scientific researchers on a steady work to ensure efficient biochemical mechanism and safety as it altered pharmacokinetic and pharmacodynamic outcome. In this study, the pH and temperature effect of Ciprofloxacin and Ibuprofen with beverages was observed and the functional group changes were noticed using Fourier-transform infrared spectroscopy (FTIR). The efficacy of pH interactions of Pepsi, Fanta, Maltina on both Ciprofloxacin (1500 mg) and Ibuprofen (1600 mg) generally increased but reduction occurred in water while temperature fluctuated. FTIR spectra obtained from Maltina showed similarity in functional groups recorded with little exception.

Key words: Food-drug, Pharmacokinetic, Pharmacodynamic, Ciprofloxacin, Ibuprofen.

Introduction

The interaction between food and drugs has a way of reducing or increasing effect of drug which may result in posing risk in treatment failure and toxicity. This effect could elongate the healing process of patent, thereby causing unwholesome situation. The need to strategically identify and prevent the development of food interactions can't be overemphasized even though the extent of the problem is unknown [1]. Food and drugs interactions are classified into pharmacokinetic (deals with effect on food absorption, metabolism, distribution or elimination of drug) and pharmacodynamics (effect and modes of action of drugs upon the body) interactions [2]. Changes that occur in the absorption of a drug as a result of chemical interactions between the food and the drug (chelation) or the physiological response to food intake serves as the most important pharmacokinetic food-drug interactions [3]. Studies had been made on mechanism that occurred pertaining to metabolism, distribution, absorption and elimination, for example, the interaction of drug with grape juice revealed that grape juice has a potent inhibitors of the cytochrome P450 (CYP) 3A4 system, which has effect on the increase of bioavailability of drugs that undergo important pre-systemic metabolism by CPY3A4 [4]. Information regarding drug interactions that involve the cytochrome P450 (CYP_{450}) enzyme system has been made known to the public [5, 6, 7].

The presence of food in the digestive tract may reduce absorption of a drug. Often time, such interactions can be avoided by taking the drug one hour or two hour after eating. Dietary fiber also affects absorption of drugs. For instance, pectin and other soluble fibers slow down the absorption of acetaminophen, a well-known pain killer drug [8].

Ciprofloxacin is a quinolone based antibacterial agent used to treat a variety of infections. The presence of casein and calcium in milk decrease the absorption of ciprofloxacin drug intake [9].

Ibuprofen, a propionic acid derivative was discovered by a team led by Stewart Adams during 1960s by the research arm of Boot Group. It's sometimes used for the acne because of its anti-inflammatory properties. Ibuprofen has a neuro-protective effect against the risk of developing Parkinson's disease [10]. An ideal system for studying drug interactions is to primarily use human hepatocyte culture systems

for they maintain both phase I and phase II activity and form and maintain physiologic processes such as biliary canaliculi and transporters [11, 12].

The aim of this study is to investigate the effect of pH, temperature and possibility of changes in functional group in the structure of Ciprofloxacin and Ibuprofen when mixed with Maltina, Fanta and Pepsi

Materials and methods

Each brand of carbonated soft drink was purchased locally from supermarkets in Abeokuta, Ogun State. The selected drugs used in this investigation were from two drug classes that are popularly used in Nigeria. They include; Antibiotics – Ciprofloxacin and Non-steroidal anti-inflamatory drugs – Ibuprofen tablets. The beverages selected are; Bottled water – Control set-up, Fanta, Maltina and Pepsi which are common carbonated soft drinks (CSDs) in Nigeria. The resulting mixture was analyzed using Schimadzu model FTIR spectrometer.

Sample preparation

The drug samples were classed into four varying doses: Ciprofloxacin doses of 500 mg, 1000 mg, 1500 mg and 2000 mg were taken, while ibuprofen was taken in doses of 400 mg, 800 mg, 1200 mg and 1600 mg. Individual mixtures were prepared by dissolving each drug dose in 50 mL of Fanta, Pepsi, Maltina, and Bottled water respectively in covered glass beakers. The pH and temperature measurements were taken and recorded at 10 minute intervals for each set-up. The pH and temperature of each set-up was monitored throughout the total dissolution period for each drug dose.

Each of the prepared mixtures and blank samples were also analyzed using Fourier-transform infrared spectroscopy (FTIR) after complete dissolution, to detect possible functional group differences from the blank samples. The spectra were recorded using an IR Prestige-21 Fourier transform infrared spectrophotometer from the Shimadzu Corporation from 4000 – 400 cm^{-1} using KBr discs

Results and Discussions

pH and Temperature variation patterns between Ciprofloxacin and Ibuprofen on the beverages

Figures 1- 4 show the pH and temperature trends respectively for ciprofloxacin and Ibuprofen in each studied beverage. As shown in Figure 1, it can be deduced that the addition of Ciprofloxacin to Maltina, Pepsi and Fanta resulted in corresponding increase in the pH of the beverage. More so, as the dosage of the Ciprofloxacin increased from 500 mg to 2000 mg the pH increased with time except for water that gave a reduction in pH from about 7.0 to 4.5 and remained constant after 20 minutes.

The increase in pH shows that there are interactions between chemical compounds in Maltina and Ciprofloxacin as well as Pepsi and Fanta with Ciprofloxacin.

Similarly, the addition of Ibuprofen to Fanta and Pepsi showed an increase in pH. At 50 and 140 minutes, the pH increased from 2.63 to 2.83 and within 120 minutes, the pH increased from 2.64 to 3.07 with an increase in dosage from 400 mg to 1600 mg (Figure 1-2). The addition of Ibuprofen to water revealed a reduction in pH from about 6.93 to 4.18. Interaction between Ibuprofen and Maltina showed variation at different time interval. 400 mg and 800 mg of Ibuprofen showed a decrease in the pH between 0 minutes and 30 minutes, while increase in the dosage between 1200 mg and 1600 mg brought about fluctuation in the pH, yet an appreciable increase in the pH for all the dosages between 40 minutes and 150 minutes was shown.

Addition of Ciprofloxacin and Ibuprofen to the drinks used comparatively revealed a fluctuation in temperature. The temperature fluctuations in Figures 3 and 4 can be attributed to changes in the ambient temperature, as the analysis was not carried out in a temperature controlled environment [13].

Figs. 5 and 6 showed the FTIR spectra of 1500 mg Ciprofloxacin and 1600 mg Ibuprofen in Maltina. Peaks at 3394 cm^{-1} and 3404 cm^{-1} indicated the presence of O-H stretch, and peaks at 1629 cm^{-1} and 1635 cm^{-1} showed the

presence of C=C stretch of an alkene respectively. Also, peaks at 1030 cm^{-1} and 2931 cm^{-1} which could indicate C-O stretch, and C-H stretch were found in both 1500 mg of Ciprofloxacin and 1600 mg Ibuprofen in Maltina.

Conclusion

There was a noticeable increase in pH when Pepsi and Fanta were combined with Ciprofloxacin and Ibuprofen. The interaction of Maltina in Ciprofloxacin shows an increase in pH while in Ibuprofen, there was an initial decrease in pH and thereafter, the pH increased. The interaction of Bottled water in both Ciprofloxacin and Ibuprofen decreased the pH. The FTIR spectra obtained from the combination of Maltina with both 1500 mg of Ciprofloxacin and 1600 mg of Ibuprofen showed much similarity with few exceptions that included the presence of C=O that was found in the interaction of Maltina with Ciprofloxacin (1500 mg) at 1732 cm^{-1} and was absent in Ibuprofen (1600 mg). The presence of N-H bend with a sharp peak at 1629 cm^{-1} was found in Maltina with Ciprofloxacin and a broad peak at 1635 cm^{-1} was found in Maltina with Ibuprofen (1600 mg). There is the tendency of these interactions to cause increase in fluid pH in human body, which will necessitate further studies in animal model.

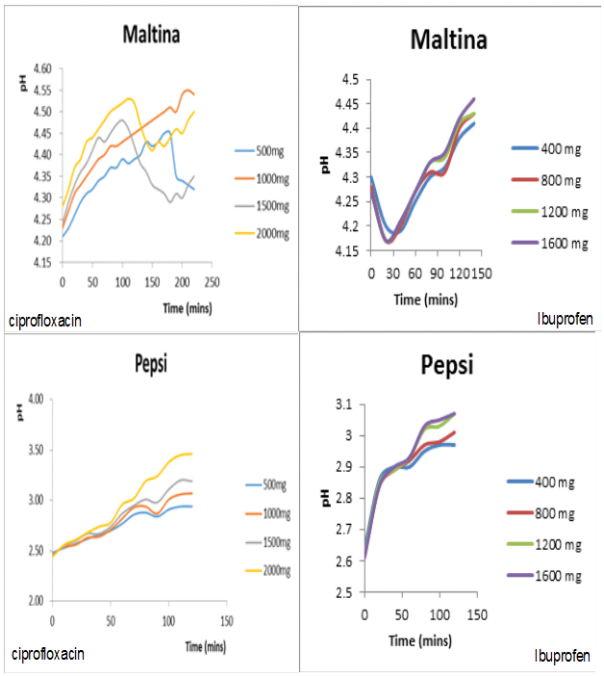

Fig 1: pH trends for Ciprofloxacin and Ibuprofen in each beverage used

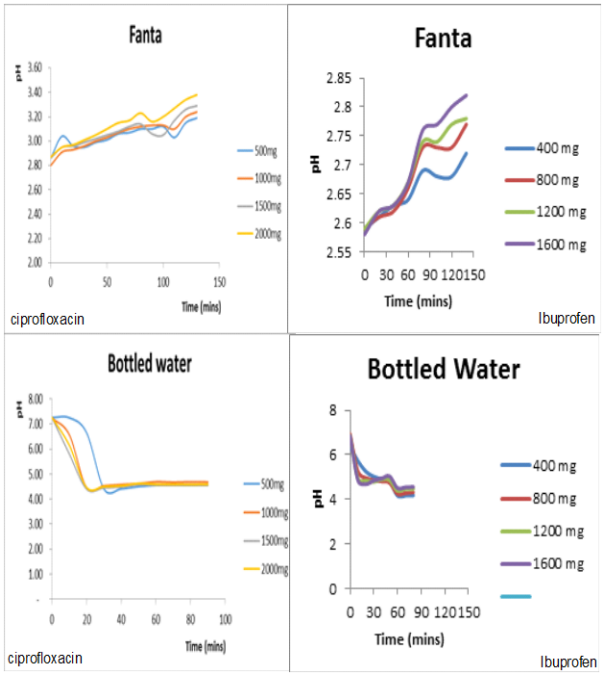

Fig 2: pH trends for Ciprofloxacin and Ibuprofen in each beverage used

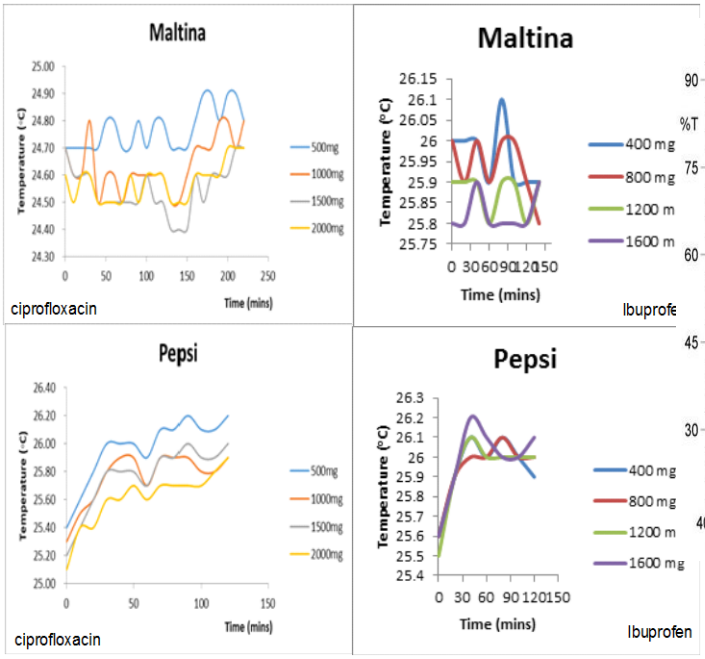

Fig 3: Temperature trends for Ciprofloxacin and Ibuprofen in each beverage used.

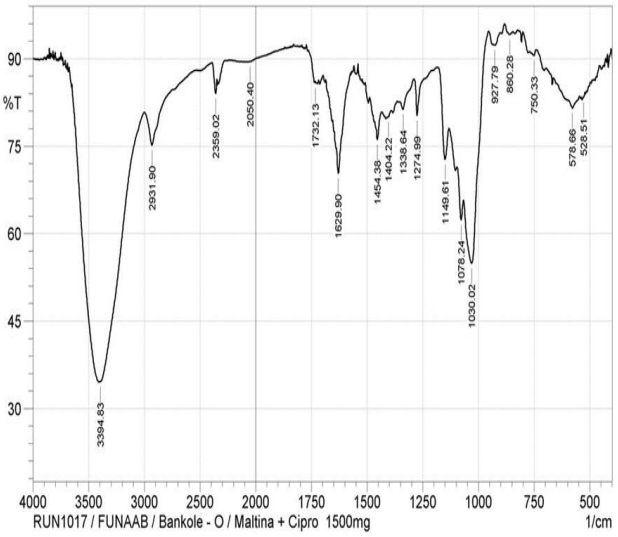

Fig. 5: FTIR spectrum of Maltina with Ciprofloxacin

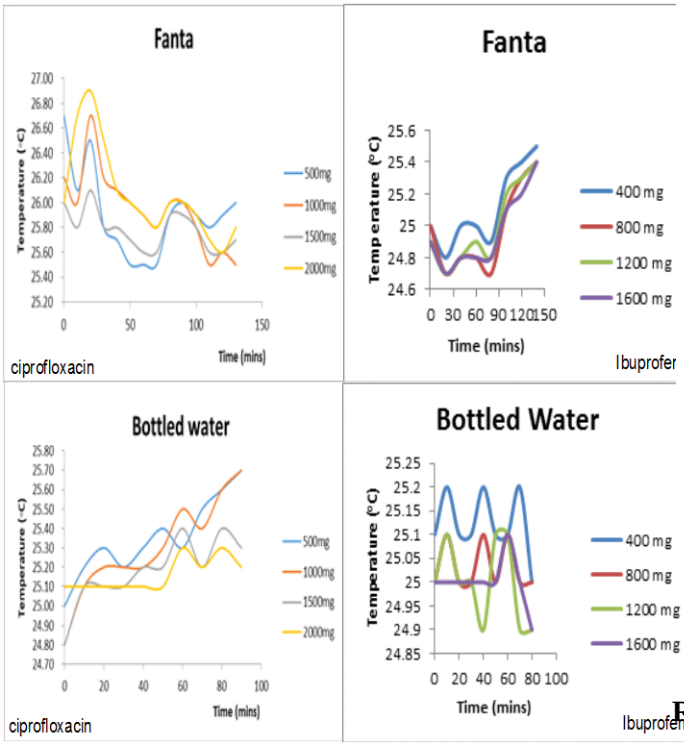

Fig 4: Temperature trends for Ciprofloxacin and Ibuprofen in each beverage used.

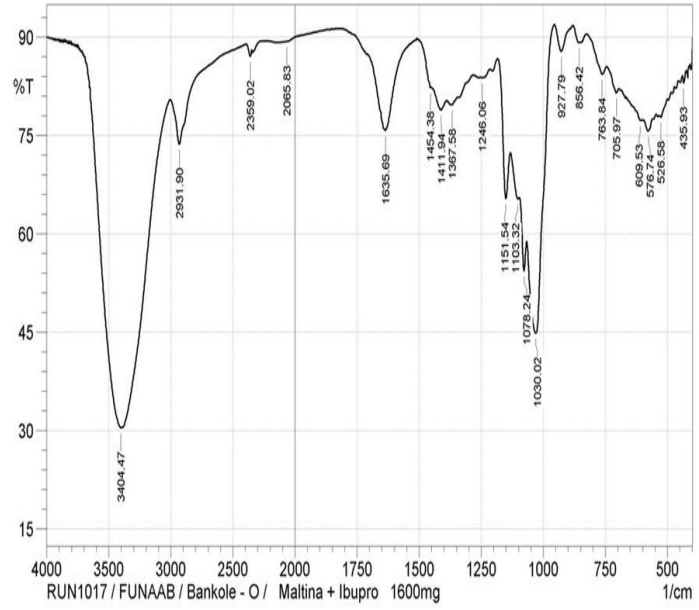

Fig. 6: FTIR spectrum of Maltina with Ibuprofen

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